As used herein, the phrase "modulate production of a secondary metabolite" refers to a positive or negative or desirable change in one or more of the variables or values that affect the process or results of production of the primary or secondary metabolites in a liquid or solid state fungal fermentation. These positive or negative or desirable changes include, without limitation, an increase or decrease in the amount of a primary or secondary metabolite being produced (in absolute terms or in quantity per unit volume of fermentation broth or per unit mass of solid substrate); a decrease in the volume of the broth or the mass/quantity of substrate required for the production of sufficient quantities; a decrease in the cost of raw materials and energy, the time of fermentor or culture run, or the amount of waste that must be processed after a fermentor run; an increase or decrease in the specific production of the desired metabolite (both in total amounts and as a fraction of all metabolites and side products made by the fungus); an increase or decrease in the percent of the produced secondary metabolite that can be recovered from the fermentation broth or culture; and an increase in the resistance of an organism producing a primary or secondary metabolite to possible deleterious effects of contact with the secondary metabolite.

In certain embodiments of aspects of the invention, a secondary metabolite is an anti-bacterial. An "anti-bacterial" is a molecule that has cytocidal or cytostatic activity against some or all bacteria. Preferred anti-bacterials include, without limitation, β-lactams. Preferred β-lactams include, without limitation, penicillins and cephalosporins and biosynthetic intermediates thereof. Preferred penicillins and biosynthetic intermediates include, without limitation, isopenicillin N, 6-aminopenicillanic acid (6-APA), penicillin G, penicillin N, and penicillin V. Preferred cephalosporins and biosynthetic intermediates include, without limitation, deacetoxycephalosporin V (DAOC V), deacetoxycephalosporin C (DAOC), deacetylcephalosporin C

(DAC), 7-aminodeacetoxycephalosporanic acid (7-ADCA), cephalosporin C, 7-B-(5-carboxy-5-oxopentanamido)-cephalosporanic acid (keto-AD-7ACA), 7-B -(4-carboxybutanamido)-cephalosporanic acid (GL-7ACA), and 7-aminocephalosporanic acid (7ACA).

In certain embodiments of aspects of the invention, the secondary metabolite is an anti-hypercholesterolemic or a biosynthetic intermediate thereof. An "anti-hypercholesterolemic" is a drug administered to a patient diagnosed with elevated cholesterol levels for the purpose of lowering the cholesterol levels. Preferred anti-hypercholesterolemics include, without limitation, lovastatin, mevastatin, simvastatin, and pravastatin.

According to other embodiments of the invention, a secondary metabolite is an immunosuppressant or a biosynthetic intermediate thereof. An "immunosuppressant" is a molecule that reduces or eliminates an immune response in a host when the host is challenged with an immunogenic molecule, including immunogenic molecules present on transplanted organs, tissues or cells. Preferred immunosuppressants include, without limitation, members of the cyclosporin family and beauverolide L. Preferred cyclosporins include, without limitation, cyclosporin A and cyclosporin C.

In certain embodiments of aspects of the invention, the secondary metabolite is an ergot alkaloid or a biosynthetic intermediate thereof. An "ergot alkaloid" is a member of a large family of alkaloid compounds that are most often produced in the sclerotia of fungi of the genus Claviceps. An "alkaloid" is a small molecule that contains nitrogen and has basic pH characteristics. The classes of ergot alkaloids include clavine alkaloids, lysergic acids, lysergic acid amides, and ergot peptide alkaloids. Preferred ergot alkaloids include, without limitation, ergotamine, ergosine, ergocristine, ergocryptine, ergocornine, ergotaminine, ergosinine, ergocristinine, ergocryptinine, ergocorninine, ergonovine, ergometrinine, and ergoclavine.

In certain embodiments of aspects of the invention, the secondary metabolite is an inhibitor of angiogenesis or a biosynthetic intermediate thereof. An "angiogenesis inhibitor" is a molecule that decreases or prevents the formation of new blood vessels. Angiogenesis inhibitors have proven effective in the treatment of several human diseases including, without limitation, cancer, rheumatoid arthritis, and diabetic retinopathy. Preferred inhibitors of angiogenesis include, without limitation, fumagillin and ovalicin.

In certain embodiments of aspects of the invention, the secondary metabolite is a glucan synthase inhibitor or a biosynthetic intermediate thereof. A "glucan synthase inhibitor" is a molecule that decreases or inhibits the production of 1,3-β-D-glucan, a structural polymer of fungal cell walls. Glucan synthase inhibitors are a class of antifungal agents. Preferred glucan synthase inhibitors include, without limitation, echinocandin B, pneumocandin B, aculeacin A, and papulacandin.

In certain embodiments of aspects of the invention, the secondary metabolite is a member of the gliotoxin family of compounds or a biosynthetic intermediate thereof. The "gliotoxin family of compounds" are related molecules of the epipolythiodioxopiperazine class. Gliotoxins display diverse biological activities, including, without limitation, antimicrobial, antifungal, antiviral, and immunomodulating activities. Preferred members of the "gliotoxin family of compounds" include, without limitation, gliotoxin and aspirochlorine.

In certain embodiments of aspects of the invention, the secondary metabolite is a fungal toxin or a biosynthetic intermediate thereof. A "fungal toxin" is a compound that causes a pathological condition in a host, either plant or animal. Fungal toxins could be mycotoxins present in food products, toxins produced by phytopathogens, toxins from poisonous mushrooms, or toxins produced by zoopathogens. Preferred fungal toxins include, without limitation, aflatoxins, patulin,